

## SERVICE DE SPECTROMETRIE DE MASSE DE L'ISIC (SSMI)

**Dr. Laure Menin**  
**Francisco Sepulveda**  
EPFL-SB-ISIC  
SSMI, BCH 1524  
CH-1015 Lausanne  
Suisse  
Phone: +41 21 693 94 64  
Fax: +41 21 693 97 50  
Laure.menin@epfl.ch

**Pr. Yury O. Tsybin, Directeur**  
EPFL-SB-ISIC  
LSMB, BCH 4312  
CH-1015 Lausanne  
Suisse  
Phone: +41 21 693 97 51  
Fax: +41 21 693 97 00  
Yury.tsybin@epfl.ch



### *ANALYSES GC-MS*

Le 07 Avril 2011

**Objet:** Analyse d'une huile essentielle par GC-MS  
**Nom:** **Epinette noire**  
**Lot:** **ENB366N16**  
**Destinataire :** Entreprise Gedane (Lausanne, Suisse)  
**Composés majoritaires:**  **$\alpha$ -Pinene ; Camphene ; Bornyl Acetate**

---

### *CONDITIONS EXPERIMENTALES*

---

**Type d'instrument :** GC CP-3800 couplé au 1200L Triple quadrupole MS/MS (Varian)  
**Mode d'ionisation :** Impact électronique (IE), 70 eV (mode positif)  
**Gamme de masse :**  $m/z$  50-250 en 0.5 sec  
**Colonne :** FactorFour VF-5ms (5% phenyl-methyl 95% dimethyl polysiloxane, 0.25mm x 30 m)  
**Débit :** 1 mL/min  
**Gradient :** 50°C pendant 3 min; Montée à 150°C en 20 min; Montée à 250°C en 7 min  
**Calibrant :** FC43  
**Echantillons :** Huile essentielle diluée 1:500 dans l'éther. Injection de 1  $\mu$ L.

---

Figure 1 – Chromatogramme TIC-GC/MS d'huile essentielle d'épinette noire (ENB366N16) analysée sur colonne capillaire

FactorFour VF-5ms (5% phenyl-methyl 95% dimethylpolysiloxane, 0.25mm x 30 m). Les numéros des pics sont reportés dans la Table 1.

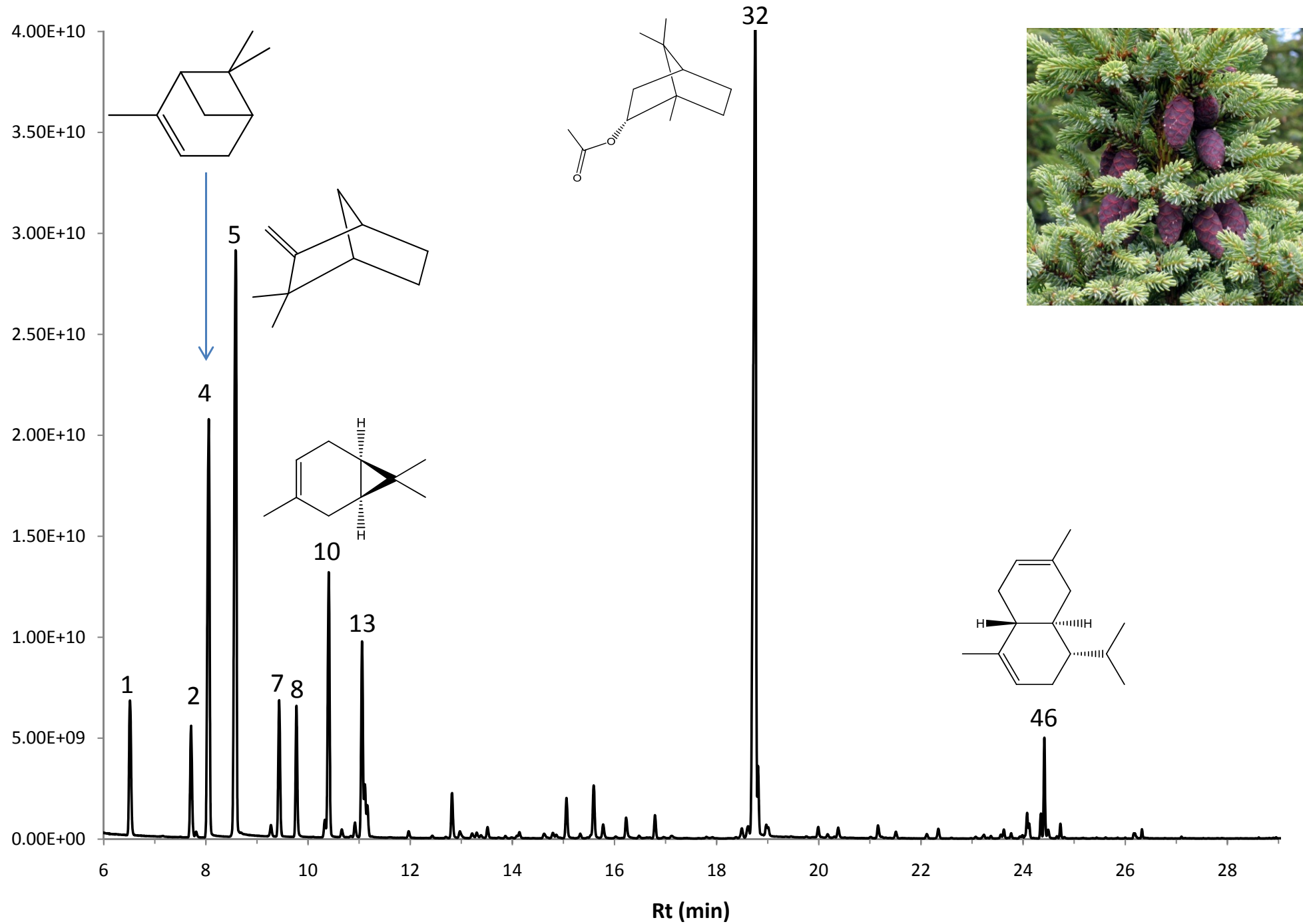


Table 1 – Composition de l'huile essentielle d'Épinette noire (ENB366N16)

N°	Retention Time (min.)	Area	% of Total	Identification (NIST 08/MassFinder)	Prob (%)
<b>1</b>	<b>6.51</b>	<b>1.85E+10</b>	<b>3.60</b>	<b>Santene</b>	<b>56</b>
<b>2</b>	<b>7.71</b>	<b>1.44E+10</b>	<b>2.80</b>	<b>Tricyclene</b>	<b>79</b>
3	7.81	5.19E+08	0.10	$\alpha$ -Thujene	89
<b>4</b>	<b>8.06</b>	<b>6.32E+10</b>	<b>12.29</b>	<b><math>\alpha</math>-Pinene</b>	<b>74</b>
<b>5</b>	<b>8.58</b>	<b>9.20E+10</b>	<b>17.87</b>	<b>Camphene</b>	<b>81</b>
6	9.27	1.42E+09	0.28	Sabinene	84
<b>7</b>	<b>9.44</b>	<b>1.71E+10</b>	<b>3.32</b>	<b><math>\beta</math>-Pinene</b>	<b>87</b>
<b>8</b>	<b>9.77</b>	<b>1.53E+10</b>	<b>2.98</b>	<b><math>\beta</math>-Pinene</b>	<b>72</b>
9	10.33	1.93E+09	0.37	$\alpha$ -Phellandrene	69
<b>10</b>	<b>10.41</b>	<b>3.39E+10</b>	<b>6.59</b>	<b>D-3-Carene</b>	<b>93</b>
11	10.66	9.08E+08	0.18	$\alpha$ -Terpinene	65
12	10.92	1.77E+09	0.34	p-Cymene	86
<b>13</b>	<b>11.06</b>	<b>2.36E+10</b>	<b>4.59</b>	<b>Limonene</b>	<b>62</b>
14	11.11	5.69E+09	1.11	$\beta$ -Phellandrene	41
15	11.16	3.53E+09	0.69	Eucalyptol	89
16	11.97	8.39E+08	0.16	$\gamma$ -Terpinene	85
17	12.82	5.54E+09	1.08	Terpinolene	42
18	12.97	1.09E+09	0.21	Fenchone	73
19	13.30	7.35E+08	0.14	Linalol	70
20	13.52	1.33E+09	0.26	$\alpha$ -Thujone	79
21	13.86	2.84E+08	0.06	$\beta$ -Thujone	44
22	14.14	8.09E+08	0.16	$\alpha$ -Campholenal	68
23	14.62	8.11E+08	0.16	Trans-Sabinol	34
24	14.79	7.77E+08	0.15	Camphor	76
25	14.86	5.61E+08	0.11	$\alpha$ -Citronellal	59
26	15.06	4.99E+09	0.97	3-Methylcamphenilol	20
27	15.33	5.74E+08	0.11	Isoborneol	72
28	15.59	6.98E+09	1.36	Borneol	72
29	15.78	1.82E+09	0.35	4-Terpineol	74
30	16.23	2.74E+09	0.53	$\alpha$ -Terpineol	71
31	16.79	2.68E+09	0.52	Fenchyl Acetate	83
<b>32</b>	<b>18.76</b>	<b>1.52E+11</b>	<b>29.52</b>	<b>Bornyl Acetate</b>	<b>52</b>
33	18.81	7.05E+09	1.37	Isobornyl Acetate	31
34	18.97	1.70E+09	0.33	Eucarvone	22
35	19.99	1.28E+09	0.25	4-Terpineol Acetate	15
36	20.38	1.41E+09	0.27	BicycloElemene	25
37	21.16	1.66E+09	0.32	Neryl Acetate	65
38	21.51	8.26E+08	0.16	cis- $\beta$ -Elemene	69
39	22.12	5.66E+08	0.11	Longifolene	67

Table 1 – Composition de l'huile essentielle d'Epinette noire (ENB366N16) (Fin)

N°	Retention Time (min.)	Area	% of Total	Identification (NIST 08/MassFinder)	Prob (%)
40	22.34	1.26E+09	0.24	$\beta$ -Caryophyllene	47
41	23.23	5.34E+08	0.10	$\alpha$ -Humulene	69
42	23.62	9.24E+08	0.18	Germacrene D	61
43	24.08	2.81E+09	0.55	$\alpha$ -Amorphene	82
44	24.12	1.28E+09	0.25	$\gamma$ -Amorphene	81
45	24.35	2.27E+09	0.44	$\gamma$ -Cadinene	74
<b>46</b>	<b>24.42</b>	<b>9.56E+09</b>	<b>1.86</b>	<b><math>\omega</math>-Cadinene</b>	<b>67</b>
47	24.49	6.07E+08	0.12	Isocalamenene	79
48	24.73	1.43E+09	0.28	$\alpha$ -Bisabolene	62
49	26.17	4.25E+08	0.08	$\tau$ -Cadinol	65
50	26.33	7.07E+08	0.14	$\alpha$ Cadinol	77

Table 1 – Composition de l'huile essentielle d'Épinette noire (ENB366N16)

N°	Retention Time (min.)	Area	% of Total	Identification (NIST 08/MassFinder)
1	6.51	1.85E+10	3.60	Santene
2	7.71	1.44E+10	2.80	Tricyclene
3	7.81	5.19E+08	0.10	$\alpha$ -Thujene
4	8.06	6.32E+10	12.29	$\alpha$ -Pinene
5	8.58	9.20E+10	17.87	Camphene
6	9.27	1.42E+09	0.28	Sabinene
7	9.44	1.71E+10	3.32	$\beta$ -Pinene
8	9.77	1.53E+10	2.98	$\beta$ -Pinene
9	10.33	1.93E+09	0.37	$\alpha$ -Phellandrene
10	10.41	3.39E+10	6.59	D-3-Carene
11	10.66	9.08E+08	0.18	$\alpha$ -Terpinene
12	10.92	1.77E+09	0.34	p-Cymene
13	11.06	2.36E+10	4.59	Limonene
14	11.11	5.69E+09	1.11	$\beta$ -Phellandrene
15	11.16	3.53E+09	0.69	Eucalyptol
16	11.97	8.39E+08	0.16	$\gamma$ -Terpinene
17	12.82	5.54E+09	1.08	Terpinolene
18	12.97	1.09E+09	0.21	Fenchone
19	13.30	7.35E+08	0.14	Linalol
20	13.52	1.33E+09	0.26	$\alpha$ -Thujone
21	13.86	2.84E+08	0.06	$\beta$ -Thujone
22	14.14	8.09E+08	0.16	$\alpha$ -Campholenal
23	14.62	8.11E+08	0.16	Trans-Sabinol
24	14.79	7.77E+08	0.15	Camphor
25	14.86	5.61E+08	0.11	$\alpha$ -Citronellal
26	15.06	4.99E+09	0.97	3-Methylcamphenilol
27	15.33	5.74E+08	0.11	Isoborneol
28	15.59	6.98E+09	1.36	Borneol
29	15.78	1.82E+09	0.35	4-Terpineol
30	16.23	2.74E+09	0.53	$\alpha$ -Terpineol
31	16.79	2.68E+09	0.52	Fenchyl Acetate
32	18.76	1.52E+11	29.52	Bornyl Acetate
33	18.81	7.05E+09	1.37	Isobornyl Acetate
34	18.97	1.70E+09	0.33	Eucarvone
35	19.99	1.28E+09	0.25	4-Terpineol Acetate
36	20.38	1.41E+09	0.27	BicycloElemene
37	21.16	1.66E+09	0.32	Neryl Acetate
38	21.51	8.26E+08	0.16	cis- $\beta$ -Elemene
39	22.12	5.66E+08	0.11	Longifolene

Table 1 – Composition de l'huile essentielle d'Épinette noire (ENB366N16) (Fin)

N°	Retention Time (min.)	Area	% of Total	Identification (NIST 08/MassFinder)
40	22.34	1.26E+09	0.24	β-Caryophyllene
41	23.23	5.34E+08	0.10	α-Humulene
42	23.62	9.24E+08	0.18	Germacrene D
43	24.08	2.81E+09	0.55	α-Amorphene
44	24.12	1.28E+09	0.25	γ-Amorphene
45	24.35	2.27E+09	0.44	γ-Cadinene
<b>46</b>	<b>24.42</b>	<b>9.56E+09</b>	<b>1.86</b>	<b>ω-Cadinene</b>
47	24.49	6.07E+08	0.12	Isocalamenene
48	24.73	1.43E+09	0.28	α-Bisabolene
49	26.17	4.25E+08	0.08	τ-Cadinol
50	26.33	7.07E+08	0.14	α-Cadinol